LEVEL III

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FLIGHT PROFILE PERFORMANCE HANDBOOK

VOLUME VIIA – CH-47A (CHINOOK)

APRIL 1979

DEPARTMENT OF THE ARMY
US ARMY TRADOC SYSTEMS ANALYSIS ACTIVITY
WHITE SANDS MISSILE RANGE
NEW MEXICO 88002

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(9) TECHNICAL REPORT, NO. 3-78

(6) FLIGHT PROFILE PERFORMANCE HANDBOOK

VOLUME VIIA, CH-47A (CHINOOK)

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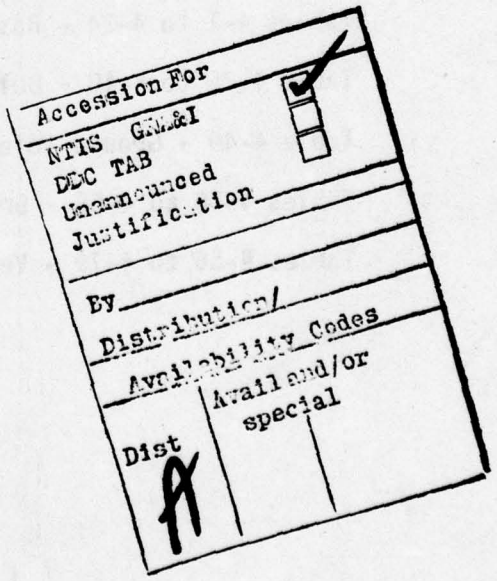

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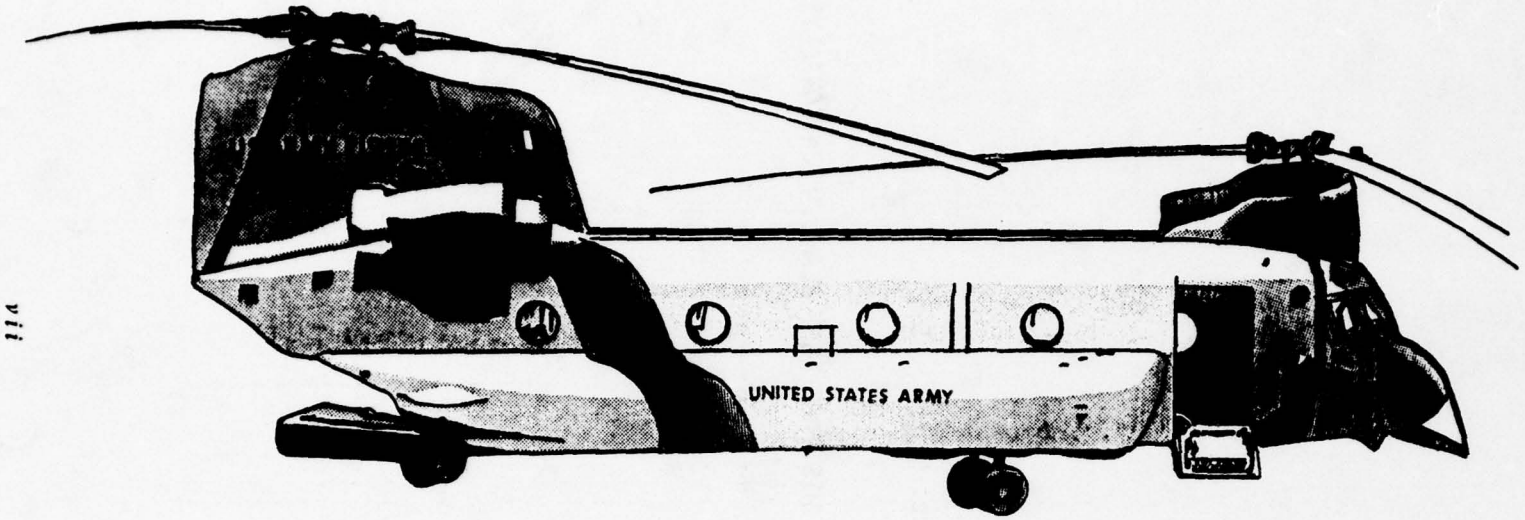


CH-47 CHINOOK

CHAPTER 1

INTRODUCTION

1. PURPOSE

The purpose for preparing this handbook series is fourfold: (a) to validate CHINOOK performance data quickly, (b) to reduce the manpower and time to prepare accurate flight profiles, (c) to standardize performance data so that the analysis community can benefit from a single reference in conducting studies and (d) to provide a handbook that can be used for training in the mission profile planning area.

2. BACKGROUND

The CHINOOK performance data contained in this Flight Profile Performance Handbook (FPPH) series was originally acquired as a data base for the Aircraft Mission Processing Simulation (AMPS) model. AMPS is a computer program developed by the Aviation Systems Analysis Branch of the US Army TRADOC Systems Analysis Activity (TRASANA) to support Cost and Operational Effectiveness Analyses (COEAs). AMPS generates detailed flight profiles for a wide variety of helicopter missions. The data was provided TRASANA by the Army Aviation Research and Development Command (AVRADCOM) and was the most accurate data available to AVRADCOM at the time of handbook publication. In structuring the data base for AMPS it was noted that the data, when properly organized, could provide a method of doing quick and simple flight profile simulations. This volume presents the CHINOOK data and explains how it can be used.

3. OBJECTIVES OF THE HANDBOOK

a. Data Validation. This volume of the handbook contains tables with the precise performance data and format required to develop flight profiles for computer simulations. Using the handbooks as a reference, the individual project manager (PM) will be able to quickly validate or update as required all associated data contained in the different tables. If this procedure is followed by the various PMs, support of Helicopter COEAs and other analyses can be efficiently implemented.

b. Flight Profile Development. Much of the manpower and time spent in preparing flight profiles for supporting aircraft COEAs is dedicated to look-up, correlation and validation of performance data. Once the procedure contained in this handbook is implemented, flight profiles can be easily prepared. What normally took one man 4 to 5 days to prepare can now be prepared in 3 to 4 hours.

c. Standardization of Performance Data. Each of the PMs has been contacted by AVRADCOM to validate the performance data contained in each handbook in this series. Once each handbook is published, the data contained will be kept current as of the publication date. Since the requests for current information are constantly being forwarded to the PMs by analysis groups, this handbook can be a reference and assure a commonality in studies within the community.

d. Training for Planning Missions and Flight Profiles. For training purposes each handbook can stand alone. It is only a matter of following the example provided and applying the proper data to fit the flight profile desired. Although the example shown is simplistic, the methodology may be expanded to apply to any flight profile no matter how complex.

4. OTHER VOLUMES

This handbook is one of a series that covers the helicopters in the US Army inventory. The complete set of handbooks and their subjects are:

Volume I - FPPH Description

Volume II - UH-60A (BLACKHAWK)

Volume III - AH-1G (COBRA)

Volume IV - AH-1S (COBRA)

Volume V - YAH-64 (Advanced Attack Helicopter [AAH])

Volume VI - OH-58C (KIOWA)

Volume VII - CH-47 (CHINOOK)

Volume VIII - CH-54 (TARHE)

Volume IX - UH-1H (HUEY)

5. GENERAL HANDBOOK DESCRIPTION

a. Performance Data. The data contained in these volumes is CHINOOK performance data compiled from the results of actual experiments. It is not engineering data and is not intended to serve as a base for future helicopter construction or acquisition. The more mature the helicopter becomes, the less likely there will be a change in the basic performance data.

b. Handbook Organization. This volume is one of a series of volumes as identified in paragraph 4 above. Volume I is a description of the methodology used to develop the tables for each of the other volumes. This volume and all other volumes except Volume I provides a simplified flight profile example in Chapter 2. Chapter 3 provides an explanation of each of the five types of data tables contained in the handbook. The five types of tables deal with: (1) Basic Fuel Flow Data, (2) Delta Fuel Flow for Drag Data, (3) Ground Idle Fuel Flow Data, (4) Gross Weight Limits Data and, (5) Velocity Limits data. Chapter 4 contains the actual tables to be used for developing flight profiles.

c. Volume VII Organization. The US Army has four different versions of the CH-47 CHINOOK. Due to the large amount of data for these four versions and to allow for easier reference, there is a separate section of Volume VII for each. Volume VIIA contains data for the CH-47A. In the same manner, Volume VIIB contains CH-47B data, Volume VIIC contains CH-47C data, and Volume VIID contains CH-47D data.

CHAPTER 2

FLIGHT PROFILE EXAMPLE

1. GENERAL

This chapter provides an example of how to develop a flight profile, albeit simple, that can be extended to cover any number of stops, loads and distances all depending on helicopter capability and fuel available.

2. DISCUSSION

a. The main question this example of a flight profile will answer is, "Do I have enough fuel to fly the proposed mission?"

b. Suppose a pilot is to fly a simple resupply mission in a CH-47A CHINOOK helicopter that calls for flying (as shown in illustration 2-1) from point A (the air base), to point B (the pick up area) to point C (the drop off area) and return to A.

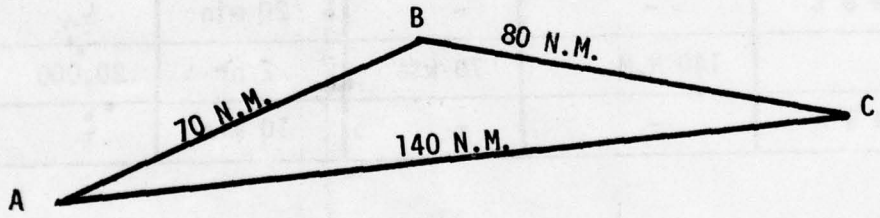


Illustration 2-1

c. The other information given is airspeed (AS) from A to B which is to be 70 knots (kts), from B to C 40 kts, and from C to A 70 kts. The CHINOOK helicopter is to be flown, at 4,000 ft for all legs at an ambient temperature of 15°C, and an idle altitude for take off, pick-up and drop off areas (ground level) of 2000 ft*. The mission plan also shows 10 minutes idle at A before take off, 20 minutes idle at B while loading, 20 minutes idle at C while unloading and 10 minutes idle on return to A before shut down. The CHINOOK will be flown empty at a gross weight (GW) of 20,000 lbs from A to B and from C to A, while the cargo from B to C will be 12,000 lbs.

All altitudes are in reference to sea level.

d. The flight plan is prepared by drawing up a table similar to Table 2-1 below. By filling in the blanks under fuel, it can be determined if the total is too large for the helicopter.

TABLE 2-1

Helicopter: CHINOOK (CH-47A)

Altitude: 4000 ft flight/2000 ft idle

Temperature: 15°C

LEG	DISTANCE	AS	TIME	GW (lbs)	FUEL
Idle @ A	-	-	10 min	-	
A-B	70 N.M.	70 kts	1 hr	20,000	
Idle @ B	-	-	20 min	-	
B-C	80 N.M.	40 kts	2 hr	32,000	
Idle @ C	-	-	20 min	-	
C-A	140 N.M.	70 kts	2 hr	20,000	
Idle @ A	-	-	10 min	-	

e. First fill in Idle @ A, Idle @ B, Idle @ C and 2nd Idle @ A since they will all come from Table 2-2. In each case the idle is at 2000 ft and a temperature of 15°C. Consulting the ground idle fuel shown in Table 2-2, the value of 1124 lbs/hr is at the intersection of 2000 ft and 15°C.

1st Idle @ A = 1/6 X 1124 = 187 lbs

Idle @ B = 1/3 X 1124 = 375 lbs

Idle @ C = 1/3 X 1124 = 375 lbs

2nd Idle @ A = 1/6 X 1124 = 187 lbs

TABLE 2-2

GROUND IDLE FUEL FLOW

AIRCRAFT - CH-47A

CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	1220	1164	1072	1000	932	860
	-5 C	1200	1144	1052	980	912	840
	15 C	1180	1124	1032	960	892	820
	35 C	1160	1104	1012	940	872	800

ENTRIES ARE AIRCRAFT FUEL FLOW RATES IN LBS/HR

TABLE 2-3

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1494	1663	1547	1432	1333	1316	1410	1586	1827	2194
24,000	1698	1922	1751	1580	1465	1442	1518	1684	1956	2447
28,000	1947	2219	2008	1797	1634	1589	1652	1827	2150	2771
32,000	2244	2599	2325	2051	1850	1777	1880	2148	2571	3320
33,000	2325	2697	2410	2123	1912	1843	1980	2279	2743	3583

Notice the conversion from minutes to hours. These values must be used because fuel flow is in lbs/hr.

f. The fuel flow for the three legs of the mission are calculated next. The heading on Table 2-1 shows a need for the Basic Fuel Flow data chart for the CHINOOK helicopter flying at 4000 ft and at 15°C ambient temperature. Table 2-3 contains the necessary information.

(1) Leg A-B is at 70 kts and 20,000 lbs. This is not one of the values given but 60 kts is 1333 lb/hr and 80 kts is 1316 lb/hr. Interpolation gives the value of 1325 lb/hr for a 70 kts airspeed. Since the leg is one hour long:

Leg A-B = 1 X 1325 = 1325 lbs

(2) Leg B-C is at 40 kts and 32,000 lbs. This value is in the table; 2051 lbs/hr. Since the leg is two hours long:

Leg B-C = 2 X 2051 = 4102 lbs

(3) Leg C-A is at 70 kts and 20,000 lbs. This fuel flow rate was computed above to be 1325 lbs/hr. Since the leg is two hours long:

Leg C-A = 2 X 1325 = 2650 lbs.

g. The flight profile can be finished by filling in Table 2-1 as shown in Table 2-4.

TABLE 2-4

Helicopter: CHINOOK (CH-47A)
Altitude: 4000 ft flight/2000 ft Idle
Temperature: 15°C

LEG	DISTANCE	AS	TIME	GW (lbs)	FUEL
Idle @ A	-		10 min	-	187 lbs
A-B	70 N.M.	70 kts	1 hr	20,000	1325 lbs
Idle @ B	-	-	20 min	-	375 lbs
B-C	80 N.M.	40 kts	2 hr	32,000	4102 lbs
Idle @ C	-	-	20 min	-	375 lbs
C-A	140 N.M.	70 kts	2 hr	20,000	2650 lbs
Idle @ A	-	-	10 min	-	187 lbs
				Total	9201 lbs

h. Although only two look-up tables were used for this example, each type of table has several conditions that are changed so that a wide band of performance parameters can be addressed. The discussion on each of the five types of tables is contained in Chapter 3. A succinct description of each of these five types of tables is:

(1) Basic Fuel Flow Data: Gives the rate the aircraft uses fuel dependent on the given flight conditions.

(2) Delta Fuel Flow for Drag Data: Gives the additional rate of fuel flow to be added to the basic rate for external drag.

(3) Ground Idle Fuel Flow Data: Gives the rate fuel is used when the aircraft is on the ground with its engine running.

(4) Gross Weight Limits Data: A check on whether or not the aircraft has enough lift to take off with a given weight.

(5) Velocity Limits Data: Gives the optimum (long range) speed and maximum rates of speed.

CHAPTER 3

PERFORMANCE DATA TABLE DESCRIPTIONS

1. GENERAL

This chapter describes each of the five basic type tables used for developing flight profiles. The variables within each type of table are described as well as how the specific data required can be extracted.

2. BASIC FUEL FLOW DATA

a. The basic rate of fuel flow* is determined by five variables:

(1) Type of aircraft

(2) Altitude (Air Pressure)**

(3) Temperature***

(4) Gross Weight****

(5) Flight Mode

b. In each table (see Table 3-1) within the basic type, the first three variables are held constant for the whole table, i.e., (a) Type of Aircraft, (b) Altitude (Air Pressure) above sea level, and (c) Temperature. These variables are stated at the top of each table.

c. There are five rows of fixed gross weights: 20,000 lbs, 24,000 lbs, 28,000 lbs, 32,000 lbs, and 33,000 lbs. The ten columns are fixed flight modes.

(1) The first column is Hover In Ground Effect (HIGE). HIGE is used for hovers at a height of 10 feet or less and a component of forward flight 10 kts or less.

(2) The second column is Hover Out of Ground Effect (HOGE). This is used for hovers at a height of more than 10 feet.

The basic fuel flow data represents a clean drag configuration with all doors closed, no wing stores, and no external sling loads.

**All altitudes or air pressures are feet above sea level.*

***For simplicity, all temperatures are considered to be the average temperature in which the helicopter is operating (Degrees Centigrade).*

****Total vehicle weight in pounds.*

(3) The third column is Nap of the Earth (NOE). This is defined as all flight for variable speeds from 0 to 40 kts and variable altitudes.

(4) The remaining seven columns are for given airspeeds* (in kts) as the flight mode.

d. There are 24 of these basic fuel flow charts. Each chart is for a different combination of Air Pressure (Altitude) and temperature.

e. The Basic Fuel Flow Data is the main table used in simulating a flight profile. For example, assume a pilot's flight path will require 30 minutes of flight at 80 kts airspeed, 4000 ft. altitude, 15°C and a gross weight of 28000 lbs in a CH-47A helicopter. Using Table 3-1 at a gross weight of 28000 lbs and an airspeed of 80 kts, the helicopter will use 1589 lbs/hr fuel, i.e., for 30 minutes, 795 lbs of fuel will be used.

f. The gross weight values selected provide the basic range of load carrying capability for the ten flight modes of the CHINOOK helicopter. Within the gross weight band shown, linear interpolation** is quite accurate for estimating the fuel flow rates.

g. For example, using Table 3-1, if the helicopter's gross weight was 30,000 lbs and if the flight mode was 60 kts, the fuel flow cannot be found directly. But by interpolating between 60 kts, 28,000 lbs - 1634 lbs/hr and 32,000 lbs - 1850 lbs/hr, the basic fuel flow rate for 30,000 lbs is 1742 lbs/hr. In this example, if the helicopter flies in this mode for 30 minutes, 871 lbs of fuel will be used.

h. As altitude and/or temperature changes occur, different tables are used to look up the aircraft's basic fuel flow rate for each leg of the flight path. Care must be taken that the proper table is used.

i. Appendix A contains a set of functions that will give a good approximation of the basic rate of fuel flow.

3. DELTA FUEL FLOW FOR DRAG DATA

a. The delta fuel flow for drag is also determined by five variables:

(1) Type of Aircraft

(2) Altitude (Air Pressure)

(3) Temperature

(4) Drag Surface (Equivalent Square Footage)

(5) Air Speed

All references to airspeeds are to true airspeeds.
**All references to interpolation are linear interpolations. See FPPH, Volume I, Chapter 8 for a discussion on the accuracy of interpolation.*

TABLE 3-1

BASIC FUEL FLOW

FULL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1494	1663	1547	1432	1333	1316	1410	1586	1827	2194
24,000	1698	1922	1751	1580	1465	1442	1518	1684	1956	2447
28,000	1947	2219	2008	1797	1634	1589	1652	1827	2150	2771
32,000	2244	2599	2325	2051	1850	1777	1880	2148	2571	3320
33,000	2325	2697	2410	2123	1912	1843	1980	2279	2743	3583

TABLE 3-2

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	14	46	109	218	380	603	891
	100	28	93	221	438	761	1198	1783
	150	42	139	333	654	1135	1797	2676
	200	56	186	446	878	1512	2395	3569

b. Like the basic fuel flow tables, there are 24 tables for delta fuel flow for drag.

c. There are four fixed rows of equivalent square feet of drag: 50 equivalent sq ft thru 200 equivalent sq ft.

d. The seven columns are for airspeeds in kts of: 40 kts, 60 kts, 80 kts, 100 kts, 120 kts, 140 kts, and 160 kts.

e. When an external load is placed on the helicopter, the amount of fuel consumed per hour increases. The delta fuel flow for drag tables indicate how much extra fuel consumption to add to the basic fuel flow rate.

f. In the example given earlier, a 30 minute flight at 80 kts airspeed, 4000 ft altitude, 15°C and a gross weight of 28,000 lbs was used. Using the basic fuel flow tables, the basic fuel flow rate was 1589 lbs/hr. Assuming for this new example that part of the load is external and inducing a 100 equivalent sq ft external drag, the delta fuel flow for drag (Table 3-2) shows 221 lbs/hr should be added to the basic fuel flow rate. Thus the basic fuel flow rate becomes 1589 † 221 or 1810 lbs per hour and for a half-hour flight, 905 lbs of fuel will be used instead of the 795 lbs figured without an external load.

g. Appendix B contains a function that will give a good approximation of the delta fuel flow for drag.

4. GROUND IDLE FUEL FLOW DATA

a. The ground idle fuel flow rate is determined by only three variables:

(1) Type of Aircraft

(2) Altitude (Air Pressure)

(3) Temperature

b. There is only one ground idle fuel flow table (shown as Table 2-2). The table has four rows of temperatures: -25°C, -5°C, 15°C and 35°C, and six columns of altitudes: Sea Level, 2000 ft, 4000 ft., 6000 ft., 8000 ft., and 10000 ft.

c. The ground idle fuel flow table is used as discussed in the example flight profile in Chapter 2 (Table 2-2). The CH-47A helicopter idling for 20 minutes at 2000 ft. altitude and 15°C, (across the row labeled 15°C and down the column labeled 2000) find the intersection at 562. Thus, the CH-47A uses 1124 lbs/hr at these conditions and since it is idling for 20 minutes or 1/3 of an hour, it will use 375 lbs of fuel.

d. If the helicopter had only been 1000 ft. above sea level, the consumption rate would be found by interpolating between the sea level rate of 1180 lbs/hr and the 2000 ft. rate of 1124 lbs/hr which would be 1152 lbs/hr. In 1/3 of an hour 384 lbs of fuel would be used.

e. Appendix C contains a function that will give a good approximation of the ground idle fuel flow.

5. GROSS WEIGHT LIMITS DATA

a. Gross weight limits tables are intended to show whether or not the aircraft can safely take off for four sets of criteria. These criteria are defined in the following paragraphs:

(1) Criteria #1 is based on the helicopter using 100% of Maximum Power for take off and having enough power to lift straight up and above ground effect (See Figure 3-1). Once it is in hovering above ground effect level the helicopter begins forward flight until it acquires, transitional lift and is able to climb at 450 ft/min (a desired standard rate of climb) to the desired altitude. This criteria has some risk since the pilot has no reserve power. It has less risk than Criteria #3 but more than Criteria #2 thus it is considered to be "Middle of the Road" risk.

(2) Criteria #2 (Figure 3-1) is based on the helicopter using 95% of Maximum Power for take off and enough power to immediately begin to climb at a rate of 450 ft/min. This is the least risky criteria since the pilot has power in reserve and is still able to climb at a satisfactory rate.

(3) Criteria #3 (Figure 3-1) has the most risk. Using 100% of Maximum Power the helicopter will only hover in ground effect. Therefore, at an altitude of 10 feet or less, the pilot must begin forward flight and gradually increase airspeed to acquire transitional lift to climb. The reasons for its high risk are readily apparent. First, there is no power in reserve. Second, the pilot must begin forward flight at a very low altitude.

(4) Criteria #4. Structural Gross Weight Limits is the total upper limit of gross weight the helicopter can carry under any take off criteria.

b. Gross Weight Limits are determined by four variables:

(1) Type of Aircraft

(2) Criteria Chosen

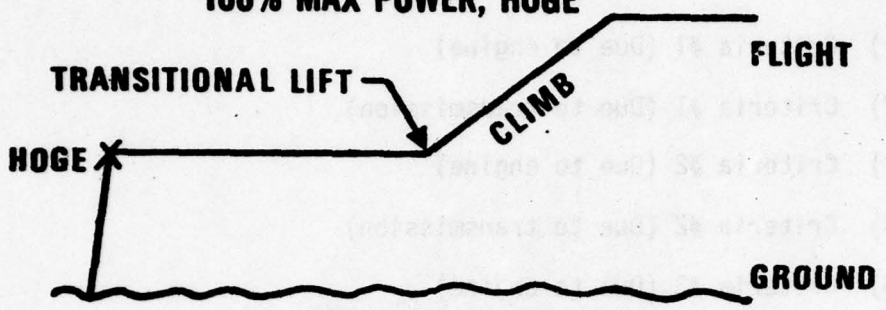
(3) Altitude (Air Pressure)

(4) Temperature

CRITERIA #1

(MIDDLE OF THE ROAD)

100% MAX POWER, HOGE

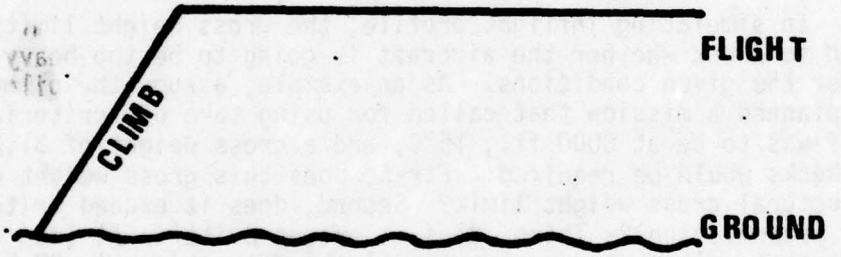


NOTHING TO SPARE.

CRITERIA #2

(LEAST RISKY)

95% OF RATED POWER. VERTICAL RATE OF CLIMB 450 FT/MIN, HOGE

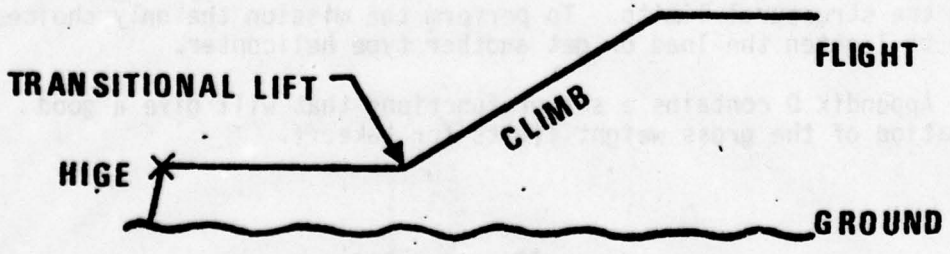


POWER LEFT

CRITERIA #3

(MOST RISKY)

100% MAX POWER, HIGE



NOTHING TO SPARE.

Figure 3-1

c. Additionally, Criteria #1, #2, and #3 differ due to engine power limits or transmission power limits of the aircraft. Thus there are six tables:

(1) Criteria #1 (Due to engine)

(2) Criteria #1 (Due to transmission)

(3) Criteria #2 (Due to engine)

(4) Criteria #2 (Due to transmission)

(5) Criteria #3 (Due to engine)

(6) Criteria #3 (Due to transmission)

d. The structural gross weight limit is a single value for each helicopter and is only dependent on the type helicopter. The CH-47A structural gross weight limit is given as 33,000 lbs and is listed at the bottom of each table. As the name implies, it is simply not safe to expect the CH-47A structure to maneuver normally when the total weight is larger than that value.

e. In simulating inflight profile, the gross weight limits tables are used to check whether the aircraft is going to be too heavy to take off under the given conditions. As an example, assume the pilot of a CH-47A planned a mission that called for using take off criteria #1 and the take off was to be at 8000 ft., 15°C, and a gross weight of 31,200. Three checks would be required: First, does this gross weight exceed the structural gross weight limit? Second, does it exceed Criteria #1 (due to transmission)? Third, does it exceed Criteria #1 (due to engine)? In the example given, the answer to all three questions is "No", the take off will not exceed aircraft limits. (Tables 3-3 and 3-4)

f. If the assigned gross weight had been 32,000 lbs, it would have exceeded the value given for 8,000 ft. and 15°C at Criteria #1 (Due to engine). (Table 3-3) The mission could not be flown as planned. The plan could be changed, for example to take off at 6000 ft. (which might not be practical) or change to take off Criteria #3 (which is more risky but has higher limits).

g. If the assigned gross weight had been 33,200 lbs., it would have exceeded the structural limits. To perform the mission the only choices would be to lighten the load or get another type helicopter.

h. Appendix D contains a set of functions that will give a good approximation of the gross weight limits for takeoff.

TABLE 3-3

GROSS WEIGHT LIMITS

(DUE TO ENGINE)

FOR TAKEOFF CRITERIA #1

100% OF MAXIMUM POWER (HOGE)

AIRCRAFT - CH-47A

CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	49222	46511	43780	41036	38116	35354
	-5 C	46130	43339	40417	37459	34732	32036
	15 C	42167	39346	36504	33859	31277	28886
	35 C	37216	34754	32301	29903	27651	25545

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 3-4

GROSS WEIGHT LIMITS

(DUE TO TRANSMISSION)

FOR TAKEOFF CRITERIA #1

100% OF MAXIMUM POWER (HOGE)

AIRCRAFT - CH-47A

CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	40975	39787	38653	37570	36481	35354
	-5 C	39712	38579	37533	36460	35352	34207
	15 C	38612	37561	36504	35413	34285	33138
	35 C	37642	36601	35527	34418	33286	32154

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

6. VELOCITY LIMITS DATA

a. There are various types of data given in these tables but like the gross weight limits tables, they are primarily restraints on what can be expected of a helicopter in planning a mission profile. Velocity limits tables are influenced by five variables:

(1) Type of aircraft

(2) Air pressure (altitude)

(3) Temperature

(4) Gross weight

(5) Condition or limit

b. Items (1) through (4) are self-explanatory. There are five types of information that can be listed under (5):

(1) Long range

(2) Maximum continuous power

(3) Maximum power (due to engine limits)

(4) Transmission limits

(5) V_{ne} (velocity never exceed)

c. For each aircraft, there are 24 Velocity Limits Tables depending on air pressure and temperature combination. Table 3-5 is an example of the content of the Velocity Limits Table.

d. The two columns under Long Range (Table 3-5) give the optimum speed and fuel flow for each set of variables #1 through #4 above. Thus the CH-47A operating at 2000 ft., temperature 15°C, and having a gross weight of 28,000 lbs will fly a longer distance if the velocity is kept at 137 kts and will use 2148 lbs/hr of fuel at that velocity.

e. Maximum continuous power gives the fastest speed at which a helicopter can fly for long periods (30 minutes or more) and the associated fuel flow rate. An example from Table 3-5 would be a CH-47A at 2000 ft. and 15° weighing 28,000 lbs could fly 164 kts with a fuel usage of 2954 lbs/hr.

TABLE 3-5

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	147	2035	193	2954	215	3396	201	3111	122	1691
24,000	142	2088	178	2954	195	3396	184	3111	122	1787
28,000	137	2148	164	2954	177	3396	169	3111	122	1899
32,000	136	2362	155	2954	166	3396	159	3111	107	1915
33,000	135	2452	152	2954	163	3396	156	3111	103	1934

f. Maximum power (engine and transmission limits) show the maximum speeds the aircraft can structurally attain for short periods of time (less than 30 minutes). Thus the CH-47A helicopter at 2000 ft and 15°C weighing 28,000 lbs has an engine that is capable of producing enough power to fly 177 kts but the transmission limits the aircraft to 169 kts. Between these two columns then, the flight cannot exceed 169 kts with a fuel flow rate of 3111 lbs/hr.

g. There is another limiting factor called V_{ne} (velocity never exceed). This velocity limit is determined by helicopter structural considerations. V_{ne}'s are used in the same manner as maximum power limits described in paragraph f above. Since a value of 122 kts is listed for 2,000 ft., 15°C, and 28,000 lbs, this implies that none of the values in d, e, or f can be reached.

7. DETAILED FLIGHT PROFILE USING ALL PERFORMANCE DATA TABLES

The example of a Flight Profile in Chapter 2 was intentionally simplified to assure clarity. The description of the various tables in this handbook, however, indicates a more complex set of considerations are normally encountered in developing the flight profile. With the description provided in this chapter, additional information should be included in the flight plan beyond that shown in the example and a suggested format is provided below in Table 3-6.

TABLE 3-6

Helicopter:
Altitude:
Temperature:

LEG	DISTANCE	AS	CHECK VELOCITY LIMIT	TIME	GW (LBS)	DRAG	FUEL

Needed for each take off:
Weight at take off:
Type of take off:
Check transmission limits:
Check engine limits:
Check structural gross weight limit:

CHAPTER 4

CHINOOK (CH-47A) PERFORMANCE DATA TABLES

GENERAL

The following tables are the major information presented in this handbook. If the procedure for using them is understood, a flight profile for the CHINOOK (CH-47A) helicopter can be prepared in a matter of a few hours. The performance data contained have been reviewed for accuracy and are corrected to the best of our knowledge. The tables are organized in the following manner:

Tables 4-1 to 4-24	Basic Fuel Flow Data
Tables 4-25 to 4-48	Delta Fuel Flow for Drag Data
Table 4-49	Ground Idle Fuel Flow Data
Tables 4-50 to 4-55	Gross Weight Limits Data
Tables 4-56 to 4-79	Velocity Limits Data

BASIC FUEL FLOW DATA

TABLES

TABLE 4-1

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	N_{OE}	40	60	80	100	120	140	160
20,000	1524	1660	1613	1566	1434	1424	1581	1852	2210	2686
24,000	1696	1888	1777	1667	1536	1525	1681	1957	2318	2879
28,000	1885	2131	1956	1781	1653	1642	1788	2064	2446	3107
32,000	2094	2389	2164	1939	1792	1776	1910	2177	2597	3420
33,000	2150	2458	2223	1988	1830	1813	1943	2207	2640	3512

TABLE 4-2

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1555	1701	1635	1569	1442	1426	1562	1793	2102	2515
24,000	1733	1933	1802	1671	1550	1532	1659	1892	2209	2675
28,000	1930	2185	1993	1801	1675	1654	1765	1996	2334	2902
32,000	2156	2456	2224	1992	1825	1793	1891	2112	2494	3213
33,000	2218	2531	2290	2048	1868	1831	1926	2148	2545	3300

TABLE 4-3

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1587	1740	1657	1574	1456	1438	1557	1762	2032	2410
24,000	1770	1978	1831	1683	1570	1549	1654	1857	2140	2584
28,000	1978	2239	2039	1839	1705	1677	1765	1956	2273	2850
32,000	2226	2533	2295	2056	1872	1824	1897	2095	2463	3174
33,000	2295	2619	2368	2116	1920	1864	1934	2145	2528	3257

TABLE 4-4

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1618	1779	1680	1582	1473	1454	1559	1746	1988	2346
24,000	1809	2023	1863	1704	1594	1571	1659	1838	2100	2542
28,000	2030	2296	2092	1888	1742	1706	1776	1942	2247	2839
32,000	2303	2627	2374	2122	1929	1863	1920	2129	2493	3170
33,000	2378	2724	2455	2185	1982	1908	1971	2205	2590	3288

TABLE 4-5

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1476	1621	1557	1492	1368	1358	1504	1758	2091	2575
24,000	1654	1857	1726	1595	1476	1466	1606	1865	2207	2764
28,000	1853	2106	1916	1726	1602	1591	1720	1974	2345	3032
32,000	2076	2379	2148	1917	1756	1736	1853	2095	2546	3393
33,000	2137	2454	2213	1973	1800	1775	1890	2133	2602	3492

TABLE 4-6

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1507	1661	1577	1494	1377	1361	1486	1701	1990	2389
24,000	1691	1902	1752	1603	1491	1474	1585	1802	2104	2574
28,000	1902	2161	1961	1762	1627	1604	1701	1909	2242	2842
32,000	2148	2459	2220	1981	1798	1755	1840	2054	2444	3213
33,000	2217	2545	2293	2040	1848	1797	1878	2105	2513	3302

TABLE 4-7

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1538	1699	1599	1499	1392	1374	1481	1671	1925	2294
24,000	1730	1947	1785	1623	1513	1492	1582	1767	2043	2503
28,000	1955	2220	2015	1811	1662	1629	1703	1878	2196	2807
32,000	2228	2558	2303	2048	1854	1789	1854	2077	2456	3149
33,000	2303	2656	2384	2111	1909	1836	1909	2157	2562	3278

TABLE 4-8

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 2000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1570	1737	1623	1509	1409	1391	1483	1655	1885	2240
24,000	1770	1992	1823	1654	1540	1516	1589	1749	2008	2478
28,000	2016	2287	2077	1867	1705	1660	1718	1882	2193	2802
32,000	2312	2666	2393	2119	1916	1840	1929	2185	2586	3307
33,000	2390	2767	2479	2191	1977	1902	2026	2311	2758	3561

TABLE 4-9

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1432	1588	1504	1421	1307	1297	1433	1670	1981	2452
24,000	1619	1829	1681	1532	1422	1412	1539	1777	2106	2671
28,000	1829	2088	1890	1692	1561	1547	1661	1890	2258	2987
32,000	2074	2384	2147	1910	1735	1704	1807	2041	2503	3380
33,000	2144	2466	2218	1969	1785	1747	1846	2094	2577	3480

TABLE 4-10

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOF	40	60	80	100	120	140	160
20,000	1463	1626	1525	1424	1318	1303	1414	1616	1887	2277
24,000	1657	1875	1712	1548	1440	1423	1519	1719	2009	2494
28,000	1884	2148	1944	1741	1592	1562	1646	1836	2172	2806
32,000	2157	2487	2232	1977	1788	1729	1804	2041	2445	3199
33,000	2234	2581	2311	2040	1843	1777	1861	2123	2550	3339

TABLE 4-11

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1494	1663	1547	1432	1333	1316	1410	1586	1827	2194
24,000	1698	1922	1751	1580	1465	1442	1518	1684	1956	2447
28,000	1947	2219	2008	1797	1634	1589	1652	1827	2150	2771
32,000	2244	2599	2325	2051	1850	1777	1880	2148	2571	3320
33,000	2325	2697	2410	2123	1912	1843	1980	2279	2743	3583

TABLE 4-12

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 4000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1526	1700	1573	1446	1353	1334	1413	1570	1791	2153
24,000	1742	1970	1795	1621	1497	1467	1528	1671	1932	2437
28,000	2016	2304	2079	1855	1685	1625	1675	1864	2186	2775
32,000	2330	2704	2423	2142	1937	1879	2031	2330	2813	3657
33,000	2417	2805	2519	2232	2032	199C	2147	2470	3013	3401

TABLE 4-13

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1394	1559	1457	1356	1252	1243	1366	1588	1880	2345
24,000	1590	1806	1644	1482	1376	1366	1478	1697	2016	2603
28,000	1815	2082	1878	1675	1532	1512	1612	1821	2217	2946
32,000	2090	2413	2162	1912	1730	1683	1774	2035	2516	3379
33,000	2165	2510	2243	1977	1785	1731	1830	2120	2630	3526

TABLE 4-14

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1425	1596	1478	1361	1264	1250	1348	1536	1792	2181
24,000	1631	1854	1683	1512	1397	1378	1462	1641	1927	2439
28,000	1880	2155	1944	1732	1570	1530	1602	1791	2134	2806
32,000	2181	2532	2259	1987	1789	1724	1839	2126	2567	3397
33,000	2261	2632	2347	2061	1852	1791	1941	2260	2747	3669

TABLE 4-15

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1456	1634	1504	1374	1282	1264	1345	1506	1738	2114
24,000	1677	1904	1729	1554	1427	1399	1463	1614	1886	2408
28,000	1952	2246	2019	1792	1621	1561	1619	1822	2159	2763
32,000	2272	2642	2363	2083	1882	1833	1992	2308	2813	3677
33,000	2357	2747	2463	2179	1981	1948	2112	2446	3015	3936

TABLE 4-16

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1489	1671	1533	1396	1303	1283	1350	1490	1707	2086
24,000	1728	1960	1781	1601	1464	1426	1476	1615	1882	2404
28,000	2025	2340	2098	1856	1676	1611	1702	1935	2299	2954
32,000	2368	2752	2487	2223	2043	2025	2172	2503	3092	4146
33,000	2463	2865	2611	2357	2175	2167	2326	2687	3346	4813

TABLE 4-17

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 8000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1361	1534	1416	1297	1203	1195	1305	1512	1789	2256
24,000	1568	1790	1621	1451	1339	1328	1426	1623	1938	2561
28,000	1817	2089	1880	1671	1516	1486	1573	1780	2187	2955
32,000	2114	2466	2198	1929	1736	1682	1812	2121	2655	3587
33,000	2192	2566	2285	2003	1800	1749	1917	2254	2844	3871

TABLE 4-18

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 8000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1392	1572	1440	1308	1217	1203	1289	1461	1706	2104
24,000	1615	1841	1667	1492	1365	1341	1413	1576	1863	2406
28,000	1892	2184	1957	1731	1564	1509	1577	1793	2151	2813
32,000	2209	2583	2306	2029	1831	1789	1963	2288	2824	3770
33,000	2294	2687	2406	2125	1935	1910	2085	2432	3030	4046

TABLE 4-19

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1425	1610	1470	1330	1237	1219	1287	1432	1659	2056
24,000	1669	1901	1721	1541	1401	1364	1417	1567	1844	2377
28,000	1969	2282	2040	1798	1620	1558	1664	1909	2291	2980
32,000	2311	2698	2440	2181	2006	1995	2151	2492	3109	4269
33,000	2407	2813	2565	2317	2144	2142	2305	2691	3385	5009

TABLE 4-20

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 6000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1460	1648	1504	1361	1261	1239	1294	1418	1635	2043
24,000	1728	1974	1782	1590	1445	1393	1437	1598	1873	2378
28,000	2045	2374	2129	1884	1710	1667	1802	2071	2514	3259
32,000	2419	2824	2616	2409	2235	2234	2404	2840	3653	5795
33,000	2517	2950	2776	2602	2410	2411	2612	3164	4266	6951

TABLE 4-21

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1334	1512	1381	1250	1161	1153	1251	1440	1708	2189
24,000	1556	1784	1610	1436	1313	1276	1382	1561	1901	2542
28,000	1834	2123	1899	1675	1514	1470	1550	1790	2218	2974
32,000	2148	2522	2247	1972	1786	1756	1942	2292	2934	3983
33,000	2234	2627	2347	2068	1889	1877	2063	2438	3152	4272

TABLE 4-22

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1367	1551	1410	1270	1177	1162	1236	1392	1631	2047
24,000	1611	1847	1666	1485	1346	1312	1373	1535	1830	2405
28,000	1915	2227	1986	1745	1568	1514	1632	1896	2299	3061
32,000	2257	2646	2389	2133	1968	1966	2128	2491	3158	4443
33,000	2354	2761	2518	2276	2104	2110	2291	2700	3454	5232

TABLE 4-23

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1403	1591	1446	1302	1200	1179	1236	1366	1592	2018
24,000	1673	1924	1730	1536	1390	1339	1388	1561	1850	2368
28,000	1995	2324	2081	1838	1667	1633	1773	2055	2522	3289
32,000	2371	2780	2585	2389	2212	2216	2404	2877	3774	6091
33,000	2469	2907	2749	2590	2398	2404	2619	3224	4451	7300

TABLE 4-24

BASIC FUEL FLOW

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: 10000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	FLIGHT MODE (KTS)									
	HIGE	HOGE	NOE	40	60	80	100	120	140	160
20,000	1443	1635	1487	1339	1229	1201	1246	1361	1582	2014
24,000	1736	2006	1798	1591	1437	1380	1458	1657	1969	2529
28,000	2083	2422	2200	1978	1823	1814	1946	2243	2785	3896
32,000	2479	2922	2827	2731	2526	2528	2759	3512	5170	8380
33,000	2593	3062	3021	2980	2751	2752	3019	3982	6212	9881

DELTA FUEL FLOW FOR DRAG DATA

TABLES

TABLE 4-25

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	19	62	147	295	510	807	1201
	100	37	124	297	589	1016	1612	2402
	150	56	187	449	887	1524	2416	3603
	200	74	250	601	1179	2031	3221	4804

TABLE 4-26

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	17	58	137	270	472	748	1109
	100	34	115	274	544	947	1492	2221
	150	51	173	413	816	1413	2236	3332
	200	68	231	554	1093	1881	2981	4443

TABLE 4-27

CORRECTION FU_{FI} FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	16	54	128	249	440	700	1036
	100	32	108	254	504	880	1390	2070
	150	47	161	383	758	1314	2082	3104
	200	63	215	514	1013	1751	2775	4138

TABLE 4-28

CORRECTION FU_{FI} FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	15	50	119	232	410	653	970
	100	30	101	238	469	819	1301	1937
	150	45	151	357	708	1232	1949	2904
	200	59	201	479	944	1638	2597	3871

TABLE 4-29

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	17	58	138	275	475	750	1117
	100	35	116	278	548	945	1498	2234
	150	52	175	419	826	1416	2246	3350
	200	70	234	559	1095	1887	2994	4467

TABLE 4-30

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	16	53	127	252	438	694	1030
	100	32	107	255	507	879	1387	2063
	150	48	161	386	760	1313	2079	3097
	200	64	215	517	1017	1749	2771	4130

TABLE 4-31

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	15	50	118	233	409	650	961
	100	30	100	237	470	819	1291	1923
	150	44	149	357	705	1222	1935	2884
	200	59	200	479	944	1628	2580	3845

TABLE 4-32

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 2000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	14	47	111	216	382	608	901
	100	28	93	221	438	763	1209	1800
	150	41	140	333	659	1146	1811	2699
	200	55	186	446	879	1523	2414	3598

TABLE 4-33

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	16	54	129	256	442	696	1037
	100	33	109	260	518	877	1390	2074
	150	49	164	391	767	1315	2085	3111
	200	65	219	520	1017	1752	2779	4148

TABLE 4-34

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	15	50	118	236	407	644	958
	100	30	100	238	471	815	1288	1917
	150	45	150	360	708	1219	1931	2877
	200	60	201	481	945	1624	2574	3836

TABLE 4-35

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	14	46	109	218	380	603	891
	100	28	93	221	438	761	1198	1783
	150	42	139	333	656	1135	1797	2676
	200	56	186	446	878	1512	2395	3569

TABLE 4-36

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	13	43	102	207	356	565	833
	100	26	86	206	408	710	1122	1669
	150	39	130	311	613	1063	1682	2504
	200	52	173	416	818	1415	2241	3339

TABLE 4-37

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	15	51	121	237	410	644	962
	100	30	102	242	473	814	1288	1924
	150	46	153	363	711	1220	1933	2886
	200	61	205	484	943	1626	2577	3848

TABLE 4-38

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	14	47	111	220	378	598	891
	100	28	94	223	437	754	1195	1781
	150	42	141	336	658	1130	1791	2671
	200	56	188	447	876	1506	2388	3562

TABLE 4-39

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	13	43	102	203	352	558	827
	100	26	87	206	407	706	1112	1655
	150	39	130	311	610	1053	1647	2484
	200	52	175	416	816	1403	2222	3312

TABLE 4-40

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 6000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	12	40	95	189	330	524	772
	100	24	81	192	380	660	1041	1547
	150	37	122	290	570	985	1559	2321
	200	49	163	388	762	1313	2078	3096

TABLE 4-41

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	14	47	113	219	380	596	892
	100	28	95	225	439	754	1193	1783
	150	42	143	337	658	1130	1790	2675
	200	56	190	449	874	1507	2387	3566

TABLE 4-42

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	13	44	104	204	351	554	825
	100	26	88	208	405	698	1107	1650
	150	39	132	312	611	1046	1659	2475
	200	52	176	415	810	1395	2212	3300

TABLE 4-43

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	12	41	96	189	325	516	769
	100	24	81	193	378	653	1031	1536
	150	36	122	290	567	975	1545	2304
	200	49	163	387	757	1299	2060	3072

TABLE 4-44

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 8000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	11	38	89	177	304	484	718
	100	23	76	180	353	612	964	1436
	150	34	114	271	529	912	1445	2154
	200	45	153	362	708	1215	1926	2872

TABLE 4-45

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	13	44	105	202	351	551	825
	100	26	88	208	407	698	1104	1651
	150	39	132	311	607	1047	1657	2476
	200	52	176	416	809	1395	2210	3301

TABLE 4-46

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	12	41	97	188	326	511	764
	100	24	82	193	376	646	1022	1528
	150	36	122	289	565	969	1534	2292
	200	48	163	384	749	1291	2046	3055

TABLE 4-47

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	11	38	90	175	302	476	710
	100	22	76	180	349	601	952	1421
	150	34	114	269	526	902	1428	2132
	200	45	152	358	699	1201	1904	2843

TABLE 4-48

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

		AIR SPEED IN KTS						
		40	60	80	100	120	140	160
DRAG IN SQUARE FEET	50	10	36	84	164	283	444	665
	100	21	71	168	326	562	889	1329
	150	31	107	252	492	843	1334	1994
	200	42	142	335	655	1124	1780	2658

GROUND IDLE FUEL FLOW DATA

TABLE

TABLE 4-49

GROUND IDLE FUEL FLOW

AIRCRAFT - CH-47A

CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	1220	1164	1072	1000	932	860
	-5 C	1200	1144	1052	980	912	840
	15 C	1180	1124	1032	960	892	820
	35 C	1160	1104	1012	940	872	800

ENTRIES ARE AIRCRAFT FUEL FLOW RATES IN LBS/HR

GROSS WEIGHT LIMITS DATA

TABLES

TABLE 4-50

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA #1
100% OF MAXIMUM POWER (HOGE)
AIRCRAFT - CH-47A
CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	49222	46511	43786	41036	38116	35354
	-5 C	46130	43339	40917	37459	34732	32036
	15 C	42167	39346	36504	33859	31277	28866
	35 C	37216	34754	32301	29903	27651	25545

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 4-51

GROSS WEIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #1
100% OF MAXIMUM POWER (HOGE)
AIRCRAFT - CH-47A
CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	40975	39787	38653	37570	36481	35354
	-5 C	39712	38599	37533	36460	35352	34207
	15 C	38612	37561	36504	35413	34285	33138
	35 C	37642	36601	35527	34418	33286	32154

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 4-52

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA #2
95% OF RATED POWER. VERTICAL RATE OF CLIMB 450 FT/MIN. OGE
AIRCRAFT - CH-47A
CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	46050	43555	41035	38490	35757	33171
	-5 C	43186	40599	37872	35098	32544	30011
	15 C	39437	36805	34145	31671	29250	27012
	35 C	34767	32466	30174	27934	25832	23864

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 4-53

GROSS WEIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #2
TRANSMISSION POWER LIMIT. VERTICAL RATE OF CLIMB 450 FT/MIN. nGE.
AIRCRAFT - CH-47A
CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	39431	38364	37277	36249	35254	34238
	-5 C	38294	37226	36214	35235	34235	33196
	15 C	37239	36240	35273	34289	33267	32209
	35 C	36316	35361	34393	33388	32347	31290

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 4-54

GROSS WEIGHT LIMITS

(DUE TO ENGINE)

FOR TAKEOFF CRITERIA #3

100% OF MAXIMUM POWER (HIGE)

AIRCRAFT - CH-47A

CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	55313	52248	49169	46077	42796	39694
	-5 C	51821	48675	45390	42068	39006	35981
	15 C	47391	44215	41022	38051	35152	32468
	35 C	41977	39166	36418	33720	31187	28816

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 4-55

GROSS WEIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #3
100% OF MAXIMUM POWER (HIGE)
AIRCRAFT - CH-47A
CHINOOK

		PRESSURE ALTITUDE (FT)					
		SEA LEVEL	2000	4000	6000	8000	10000
TEMPERATURE DEGREES CENTIGRADE	-25 C	46344	45055	43704	42327	40997	39694
	-5 C	44971	43637	42286	40972	39687	38323
	15 C	43654	42315	41022	39757	38415	37159
	35 C	42419	41137	39897	38573	37303	36317

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

VELOCITY LIMITS DATA

TABLES

TABLE 4-56

VELOCITY LIMITS TABLE
(INCLUDING FUEL FLOW RATES)
PRESSURE: SEA LEVEL TEMPERATURE: -25 C
AIRCRAFT - CH-47A
CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	131	2042	199	3671	214	4048	177	3109	130	2024
24,000	136	2236	185	3671	196	4048	167	3109	130	2126
28,000	136	2369	176	3671	186	4048	160	3109	130	2237
32,000	134	2463	166	3671	174	4048	153	3109	115	2105
33,000	134	2488	163	3671	171	4048	152	3109	111	2076

TABLE 4-57

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	142	2137	206	3531	223	3898	188	3137	130	1939
24,000	142	2248	194	3531	209	3898	178	3137	130	2039
28,000	140	2338	180	3531	192	3898	168	3137	130	2147
32,000	135	2389	168	3531	177	3898	158	3137	115	2049
33,000	135	2422	165	3531	174	3898	156	3137	111	2033

TABLE 4-58

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	147	2160	199	3192	220	3629	197	3163	130	1888
24,000	144	2225	185	3192	203	3629	184	3163	130	1985
28,000	140	2281	171	3192	185	3629	170	3163	130	2092
32,000	136	2382	160	3192	171	3629	160	3163	115	2037
33,000	136	2439	159	3192	169	3629	158	3163	111	2032

TABLE 4-59

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: SEA LEVEL TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	150	2152	184	2814	207	3243	204	3191	122	1772
24,000	145	2193	171	2814	189	3243	187	3191	122	1864
28,000	140	2256	159	2814	172	3243	171	3191	122	1969
32,000	138	2457	151	2814	162	3243	161	3191	108	1982
33,000	138	2547	147	2814	159	3243	158	3191	104	2000

TABLE 4-60

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	133	1971	195	3534	207	3853	178	3060	130	1915
24,000	137	2150	184	3534	193	3853	169	3060	130	2022
28,000	135	2248	173	3534	182	3853	161	3060	130	2137
32,000	132	2331	163	3534	170	3853	153	3060	115	2028
33,000	132	2365	161	3534	167	3853	152	3060	111	2007

TABLE 4-61

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	142	2030	202	3293	220	3681	193	3086	130	1835
24,000	141	2128	188	3293	203	3681	180	3086	130	1938
28,000	137	2190	174	3293	185	3681	167	3086	130	2051
32,000	134	2312	162	3293	171	3681	157	3086	115	1990
33,000	134	2372	160	3293	168	3681	156	3086	111	1984

TABLE 4-62

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	147	2035	193	2954	215	3396	201	3111	122	1691
24,000	142	2088	178	2954	195	3396	184	3111	122	1787
28,000	137	2148	164	2954	177	3396	169	3111	122	1899
32,000	136	2362	155	2954	166	3396	159	3111	107	1915
33,000	135	2452	152	2954	163	3396	156	3111	103	1934

TABLE 4-63

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	148	2008	179	2603	201	3037	206	3134	114	1601
24,000	142	2058	164	2603	181	3037	185	3134	114	1697
28,000	138	2162	154	2603	167	3037	170	3134	114	1823
32,000	136	2493	141	2603	154	3037	156	3134	100	1927
33,000	134	2610	134	2603	148	3037	151	3134	95	1983

TABLE 4-64

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	135	1897	195	3380	205	3651	181	3013	130	1816
24,000	136	2041	183	3380	192	3651	171	3013	130	1926
28,000	134	2137	170	3380	177	3651	161	3013	130	2048
32,000	131	2252	160	3380	166	3651	153	3013	115	1973
33,000	131	2303	158	3380	163	3651	151	3013	111	1962

TABLE 4-65

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	142	1923	198	3076	216	3445	196	3036	122	1634
24,000	140	2015	182	3076	196	3445	180	3036	122	1738
28,000	135	2074	168	3076	178	3445	166	3036	122	1856
32,000	133	2288	158	3076	166	3445	157	3036	107	1867
33,000	132	2355	155	3076	162	3445	154	3036	103	1886

TABLE 4-66

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS	F.F. (LBS/HR)
20,000	145	1913	188	2745	208	3156	203	3060	114	1523
24,000	140	1966	171	2745	186	3156	183	3060	114	1623
28,000	136	2077	159	2745	171	3156	168	3060	114	1757
32,000	133	2403	146	2745	156	3156	154	3060	99	1870
33,000	131	2520	140	2745	151	3156	149	3060	95	1928

TABLE 4-67

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	146	1881	173	2415	194	2830	207	3083	109	1437
24,000	141	1943	159	2415	174	2830	183	3083	109	1548
28,000	138	2155	149	2415	162	2830	169	3083	109	1699
32,000	131	2566	124	2415	141	2830	147	3083	85	1899
33,000	129	2676	117	2415	134	2830	142	3083	79	1987

TABLE 4-68

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HP)	VEL (KTS)	F.F. (LBS/HR)
20,000	136	1825	191	3181	201	3443	183	2968	122	1613
24,000	135	1935	178	3181	186	3443	171	2968	122	1722
28,000	132	2022	165	3181	171	3443	160	2968	122	1846
32,000	130	2230	156	3181	161	3443	152	2968	107	1846
33,000	125	2228	153	3181	158	3443	149	2968	103	1860

TABLE 4-69

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	142	1818	193	2882	208	3198	198	2991	113	1465
24,000	137	1885	176	2882	187	3198	179	2991	113	1572
28,000	134	2016	162	2882	170	3198	164	2991	113	1713
32,000	131	2340	149	2882	156	3198	151	2991	99	1825
33,000	130	2476	144	2882	151	3198	146	2991	94	1880

TABLE 4-70

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	143	1791	182	2559	200	2934	204	3012	102	1357
24,000	138	1848	165	2559	178	2934	181	3012	102	1473
28,000	135	2072	154	2559	165	2934	167	3012	102	1631
32,000	130	2518	131	2559	144	2934	146	3012	83	1844
33,000	126	2594	125	2559	138	2934	140	3012	77	1939

TABLE 4-71

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	144	1769	168	2260	186	2626	205	3033	86	1294
24,000	138	1857	155	2260	168	2626	182	3033	86	1432
28,000	135	2199	138	2260	151	2626	162	3033	86	1623
32,000	126	2658	107	2260	125	2626	138	3033	67	2015
33,000	126	2843	93	2260	117	2626	132	3033	0	0

TABLE 4-72

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	137	1746	186	2965	194	3207	184	2927	113	1437
24,000	134	1835	172	2965	179	3207	171	2927	113	1550
28,000	131	1960	160	2965	166	3207	159	2927	113	1697
32,000	124	2208	148	2965	153	3207	147	2927	99	1798
33,000	123	2335	143	2965	148	3207	142	2927	95	1855

TABLE 4-73

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	141	1719	187	2690	200	2973	199	2948	101	1294
24,000	135	1781	169	2690	179	2973	178	2948	101	1418
28,000	132	1999	157	2690	163	2973	163	2948	101	1583
32,000	126	2421	136	2690	144	2973	143	2948	82	1798
33,000	125	2550	130	2690	138	2973	138	2948	76	1897

TABLE 4-74

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	141	1679	175	2386	190	2715	202	2968	84	1225
24,000	136	1781	160	2386	171	2715	180	2968	84	1368
28,000	132	2120	144	2386	153	2715	160	2968	84	1567
32,000	125	2619	115	2386	129	2715	136	2968	65	1985
33,000	124	2794	106	2386	121	2715	130	2968	0	0

TABLE 4-75

VELOCITY LIMITS TABLE
(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	141	1655	162	2102	177	2434	201	2987	69	1241
24,000	138	1846	150	2102	162	2434	182	2987	69	1411
28,000	130	2263	122	2102	137	2434	153	2987	69	1667
32,000	120	2850	0	2102	102	2434	125	2987	0	0
33,000	114	2969	0	2102	86	2434	115	2987	0	0

TABLE 4-76

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	136	1647	182	2757	190	2984	187	2888	101	1258
24,000	132	1734	166	2757	172	2984	170	2888	101	1388
28,000	130	1960	155	2757	160	2984	158	2888	101	1558
32,000	122	2337	135	2757	141	2984	139	2888	82	1766
33,000	121	2472	130	2757	136	2984	133	2888	76	1862

TABLE 4-77

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	139	1613	179	2491	190	2746	197	2907	83	1167
24,000	134	1728	162	2491	170	2746	175	2907	83	1315
28,000	131	2083	146	2491	153	2746	156	2907	83	1521
32,000	123	2568	120	2491	129	2746	134	2907	0	0
33,000	121	2731	112	2491	122	2746	127	2907	0	0

TABLE 4-78

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	139	1576	168	2209	181	2514	198	2925	67	1184
24,000	135	1775	155	2209	165	2514	179	2925	67	1362
28,000	127	2197	128	2209	140	2514	151	2925	67	1636
32,000	116	2763	78	2209	107	2514	122	2925	0	0
33,000	113	2969	0	2209	92	2514	112	2925	0	0

TABLE 4-79

VELOCITY LIMITS TABLE
(INCLUDING FUEL FLOW RATES)

PRESSURE: 10000 FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

CHINOOK

GROSS WEIGHTS (LBS)	LONG RANGE		MAX CONTINUOUS POWER		MAX POWER (ENGINE)		TRANSMISSION LIMITS		VELOCITY NEVER EXCEED	
	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F. (LBS/HR)
20,000	139	1572	158	1952	170	2255	199	2943	0	0
24,000	135	1884	139	1952	151	2255	173	2943	0	0
28,000	126	2375	101	1952	121	2255	144	2943	0	0
32,000	111	3087	0	1952	0	2255	108	2943	0	0
33,000	105	3194	0	1952	0	2255	95	2943	0	0

APPENDIX A

FUNCTIONS FOR CALCULATING BASIC FUEL FLOW

There are four functions that can be used to calculate the basic fuel flow for the CH-47A helicopter. In order to use the functions the following data is needed:

1. Flight Mode
2. Temperature
3. Pressure (altitude)
4. Gross weight

Which of the four functions will be used depends on the flight mode. The first function is for HIGE (Hover In Ground Effect).

$$FF\ (HIGE) = f\ (TEMP, ALT, GW)$$

The second function is for HOGE (Hover Out of Ground Effect).

$$FF\ (HOGE) = f\ (TEMP, ALT, GW)$$

The third function is for NOE (Nap of the Earth).

$$FF\ (NOE) = f\ (TEMP, ALT, GW)$$

The fourth function is for Forward Flight.

$$FF\ (Forward\ Flight) = f\ (AS, TEMP, ALT, GW)$$

The equation for FF (HIGE) is:

$$FF\ (HIGE) = A\ (ALT) + B\ (TEMP) + C\ (GW) + D\ (ALT)(TEMP) + E\ (ALT)\ (GW) + F\ (TEMP)\ (GW) + G\ (ALT)\ (TEMP)\ (GW) + K$$

Where ALT is the altitude, TEMP is the temperature and GW is the gross weight and the constants have the following values:

$A = -7.15665985 \times 10^{-2}$ $\quad$ $E = 2.56930846 \times 10^{-6}$

$B = -2.3518604$ $\quad$ $F = 1.80017465 \times 10^{-4}$

$C = 5.13386521 \times 10^{-2}$ $\quad$ $G = 1.39370938 \times 10^{-8}$

$D = -2.36933309 \times 10^{-4}$ $\quad$ $K = 5.08615311 \times 10^{2}$

The equation for FF (HOGE) is exactly the same form as FF (HIGE). A new set of values for the constants is used. These values are:

$A = -7.89321018 \times 10^{-2}$	$E = 3.07750736 \times 10^{-6}$
$B = -2.75316495$	$F = 2.12039355 \times 10^{-4}$
$C = 6.41560983 \times 10^{-2}$	$G = 1.84186992 \times 10^{-8}$
$D = -3.26415004 \times 10^{-4}$	$K = 4.01074921 \times 10^{2}$

The equation for FF (NOE) is once again the same as FF (HIGE). The new values for the constants are:

$A = -1.01870282 \times 10^{-1}$	$E = 3.82094487 \times 10^{-6}$
$B = -2.33942565$	$F = 1.6026065 \times 10^{-4}$
$C = 4.94293235 \times 10^{-2}$	$G = 4.75979691 \times 10^{-8}$
$D = -9.4832739 \times 10^{-4}$	$K = 6.21096802 \times 10^{2}$

For the Forward Flight modes the form of the equation is:

$$FF = A(AS) + B(AS^2) + C(AS^3) + D(TEMP) + E(GW) + F(ALT) + G(AS^3)(TEMP) + H(AS^2)(TEMP) + I(AS)(TEMP) + J(AS^3)(GW) + K(AS^2)(GW) + L(AS)(GW) + M(AS^3)(ALT) + N(AS^2)(ALT) + O(AS)(ALT) + P(TEMP)(GW) + Q(TEMP)(ALT) + R(GW)(ALT) + S(TEMP)(GW)(ALT) + T$$

Where AS is the air speed in kts and the values of the constants are:

$A = -5.86449397$	$K = 5.84522547 \times 10^{-6}$
$B = 6.03244249 \times 10^{-2}$	$L = -8.03033821 \times 10^{-4}$
$C = 1.18214637 \times 10^{-4}$	$M = -1.0186316 \times 10^{-8}$
$D = -3.21404946$	$N = -1.55880429 \times 10^{-6}$
$E = 6.34362176 \times 10^{-2}$	$O = 2.36300752 \times 10^{-4}$
$F = -8.69411761 \times 10^{-2}$	$P = 1.57303326 \times 10^{-4}$
$G = -6.00098531 \times 10^{-7}$	$Q = -2.20658883 \times 10^{-4}$
$H = -4.51068372 \times 10^{-4}$	$R = 2.63398709 \times 10^{-6}$
$I = 4.31923866 \times 10^{-2}$	$S = 1.1124619 \times 10^{-8}$
$J = -1.36022993 \times 10^{-8}$	$T = 8.5389859 \times 10^{2}$

These functions allow anyone with a simple calculator to figure the fuel flow of the aircraft and bypass both looking up the values and interpolating for points in between the data points in the tables.

The above equations calculate the basic fuel flow for the CH-47A helicopter with the following accuracies:

FF (HIGE) - 99.33%

FF (HOGE) - 99.36%

FF (NOE) - 98.19%

FF (Forward Flight) - 98.09%

APPENDIX B

FUNCTION FOR CALCULATING DELTA-FUEL FLOW FOR DRAG

The function below will calculate the delta fuel flow for drag for the CH-47A helicopter. Recall from the discussion in chapter three that this value is added to the basic fuel flow value whenever drag is increasing the rate of fuel flow.*

In order to use the function the following data is needed:

1. Air Speed (AS)
2. Equivalent Square Footage of Drag (SQ)
3. Temperature (TEMP) in degrees centigrade
4. Altitude (ALT) in feet above sea level

That is:

$$FF\ (Drag) = f(AS, SQ, TEMP, ALT)$$

The equation for FF (Drag) is:

$$FF\ (Drag) = A(AS) + B(AS^2) + C(AS^3) + D(TEMP) + E(SQ) + F(ALT)$$
$$+ G(AS^3)(TEMP) + H(AS^2)(TEMP) + I(AS)(TEMP) + J(AS^3)(SQ) + K(AS^2)(SQ)$$
$$+ L(AS)(SQ) + M(AS^3)(ALT) + N(AS^2)(ALT) + O(AS)(ALT) + P(TEMP)(SQ)$$
$$+ Q(TEMP)(ALT) + R(SQ)(ALT) + S(SQ)(ALT)(TEMP) + T$$

Where the constants have the following values:

$A = -1.55468985$	$K = -2.21060582 \times 10^{-5}$
$B = 1.74179138 \times 10^{-2}$	$L = 2.58207321 \times 10^{-3}$
$C = 5.52420597 \times 10^{-5}$	$M = -1.4847501 \times 10^{-8}$
$D = 3.23438925$	$N = -1.75797179 \times 10^{-6}$
$E = 1.2785452$	$O = 1.58675015 \times 10^{-4}$
$F = 2.6535566 \times 10^{-2}$	$P = -2.8082402 \times 10^{-2}$
$G = -2.35626086 \times 10^{-6}$	$Q = -2.04823664 \times 10^{-6}$
$H = 1.16063618 \times 10^{-4}$	$R = -2.47788365 \times 10^{-4}$
$I = -1.08610392 \times 10^{-2}$	$S = 9.04279823 \times 10^{-7}$
$J = 4.4644508 \times 10^{-6}$	$T = -1.28185028 \times 10^{2}$

There is no delta fuel flow for drag for HIGE, HOGE or NOE flight.

This equation calculates the delta fuel flow for drag value with an accuracy of 99.67%. It should be noted that in some instances the computed value will be negative. If this occurs, zero (0) should be used as the value for delta fuel flow.

APPENDIX C

FUNCTION FOR CALCULATING GROUND IDLE FUEL FLOW

The function below will calculate the ground idle fuel flow rate for the CH-47A helicopter. In order to use the function the following data is needed:

1. Temperature (TEMP) in degrees centigrade.

2. Altitude (ALT) in feet above sea level.

That is:

$$FF\ (Idle) = f\ (TEMP, ALT)$$

The equation, for FF (Idle) is:

$$FF\ (Idle) = A(TEMP) + B(ALT) + C(TEMP)(ALT) + D(TEMP^2) + E(ALT^2) + F$$

Where the constants have the following values:

$A = -9.99999985 \times 10^{-1}$ $\quad$ $D = 1.60979201 \times 10^{-9}$

$B = -3.73999695 \times 10^{-2}$ $\quad$ $E = 7.14257675 \times 10^{-8}$

$C = -1.07357118 \times 10^{-11}$ $\quad$ $F = 1.20071422 \times 10^{3}$

This equation calculates the ground idle fuel flow rate with an accuracy of 99.75%.

APPENDIX D

FUNCTIONS FOR CALCULATING GROSS WEIGHT LIMITS FOR TAKEOFF

The functions given below will calculate the gross weight limits for take off for the CH-47A helicopter. Each of the functions is of the same basic form with the values of the constants changing depending on which take off criteria is being used. In all cases the Structural Gross Weight Limit of the CH-47A helicopter is 33,000 lbs.

In order to use the functions the following data is needed:

1. Temperature (TEMP) in degrees centigrade

2. Altitude (ALT) in feet above sea level

That is:

$$GW\ (Limit) = f\ (TEMP, ALT)$$

The basic equation for GW (Limit) is:

$$GW\ (Limit) = A(TEMP) + B(ALT) + C(TEMP)(ALT) + D$$

For take off criteria #1 the equation must be used twice, once using the engine limit constants and once using the transmission limit constants. For take off criteria #1 the constants for engine limits are:

$A = -2.03450739 \times 10^{2}$ $\qquad$ $C = 3.68664737 \times 10^{-3}$

$B = -1.34642246$ $\qquad$ $D = 4.46380747 \times 10^{4}$

For take off criteria #1 the constants for transmission limits are:

$A = -5.39452381 \times 10$ $\qquad$ $C = 1.34714452 \times 10^{-4}$

$B = -5.51487826 \times 10^{-1}$ $\qquad$ $D = 3.95164639 \times 10^{4}$

For take off criteria #2 two checks must also be made. The constants for engine limits, take off criteria #2 are:

$A = -1.91680241 \times 10^{2}$ $\qquad$ $C = 3.32721538 \times 10^{-3}$

$B = -1.25616817$ $\qquad$ $D = 4.1769603 \times 10^{4}$

For take off criteria #2 the constants for transmission limits are:

$A = -5.056429 \times 10$ $\qquad$ $C = 2.73357895 \times 10^{-4}$

$B = -5.08491784 \times 10^{-1}$ $\qquad$ $D = 3.80728213 \times 10^{4}$

Also for take off criteria #3 two checks must be made. The constants for engine limits, take off criteria #3 are:

$A = -2.2619001 \times 10^{2}$ $\quad C = 4.13450238 \times 10^{-3}$

$B = -1.51476888$ $\quad D = 5.01781396 \times 10^{4}$

For take off criteria #3 the constants for transmission limits are:

$A = -6.65571413 \times 10$ $\quad C = 8.12428523 \times 10^{-4}$

$B = -6.53947815 \times 10^{-1}$ $\quad D = 4.46635469 \times 10^{4}$

This equation with the various sets of constants gives results that are 99.79% accurate or better.

APPENDIX E

SHORT DESCRIPTION OF CHINOOK (CH-47A) DATA SOURCE

DRDAV-EQA(A)
SUBJECT: Short Description of CH-47A Performance Data Provided to TRADOC Systems Analysis Activity (TRASANA)

MFR.

1. References:

a. Operators Manual, Army Model CH-47A, TM55-1520-209-10.

b. Category II Performance tests of the CH-47A Helicopter, Air Force FTC-TR-66-2.

c. Determination of the Effects of Rotor Blade Compressibility on the Performance of the UH-1F; FTC-TR-65-17.

d. Airworthiness and Qualification Test (Phase D), CH-47B Helicopter, USAASTA Project 66-23.

2. The performance data presented to TRASANA is the result of combining the helicopter power required, engine power available and engine fuel flow characteristics. The CH-47A power required was calculated from a non-dimensional representation of engine power required (coefficient of power) v.s. gross weight (coefficient of thrust) and true airspeed (advance ratio). The non-dimensional power required was obtained from reference 1b. All performance in ground effect represents a 10 foot wheel height. A temperature dependent correction, based on the method outlined in reference 1c, was made to the power required to account for compressibility which could not be accounted for in the non-dimensional representation.

3. The T55-L-7C engine power available to the CH-47A (which was used in combination with the power required to find helicopter take-off and speed limits) was used as a function of altitude and temperature, from reference 1d.

4. The engine fuel flow at a particular altitude and temperature combination was derived from a representative referred fuel flow as a function of referred engine power. The referred fuel flow curve for the T55-L-7C engine was taken from reference 1d. The calculated fuel flows reflect 5% conservatism. A referred parameter is one which is divided by temperature and pressure ratios in order to represent all atmospheric conditions by one function.

5. The never exceed speeds (Vn.e.) were calculated from those shown graphically in reference 1a.

6. The Structural Gross Weight limit of the CH-47A is 33000 lbs.

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